

Let's save the bees! An environmental activism initiative in elementary school.

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Abstract.

Science education research emphasizes the need to engage students in socio-scientific issues, empowering them to act in a substantiated manner. This study aims to understand the potential of a collective action initiative, focused on the decreasing honey production issue, and on the students' empowerment for action. A qualitative research methodology was used with an interpretative stance. The participants were 26 3rd grade students and their teacher. Data was collected from the students written documents, and through an interview with the teacher. Results show that students' engagement in collective action focused on the decreasing honey production issue, required them to mobilize their scientific knowledge to support their actions, as well as the development of several other competences. Students also became aware of the importance, for every citizen, to substantiate their knowledge in order to act, that acting is crucial to overcome issues that may persist and impact future generations, and that only by engaging in action can change take place. Another highlight was the students' strong engagement in collective action, allowing them to raise awareness this issue in their local community.

Key words. activism, collective action, science education, scientific literacy, socio-scientific issues.

ISSN 2384-8677

DOI: <http://dx.doi.org/10.13135/2384-8677/2772>

Article history: Submitted February 12, 2018. Accepted May 07, 2018

Published online: June 04, 2018

Citation: Baptista, M., Reis, P., de Andrade, V. (2018). Let's save the bees! An environmental activism initiative in elementary school. *Visions for Sustainability*, 9: 41-48.

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Competing Interests: The authors have declared that no competing interests exist.

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Perspective: Educational visions

Fields: Earth Life Support Systems

Issues: Honey Production, Collective Action

Introduction

Recognizing the importance of science in our lives, several authors emphasize the need for students to develop a scientific attitude, meaning, to critically analyse the produced knowledge, distinguishing between scientific knowledge and common-sense knowledge, appreciating different assertions, critically analysing their limits and potentialities, among other aspects (e.g., Lederman, 2006). This implies that students develop not only scientific knowledge (i.e., concepts, facts, relevant theories that constitute an entire body of fundamental knowledge), but also knowledge about science (i.e., the way that this activity works, how knowledge is constructed, and the nature of this knowledge) allowing them to develop a critical perspective about what is being presented and about which they have to take a stance (Schwartz, Lederman & Crawford, 2004). Moreover, science education must go beyond the learning of knowledge and scientific skills, to focus on problem solving, and on the ability to negotiate solutions through open and critical dialogue, giving students the opportunity to actively participate in society. In order to achieve these goals, it is essential to engage students in solving social problems with a scientific and technological nature, giving a useful and concrete meaning to science, allowing them to better understand the society they live in, and how science can contribute to environmental sustainability and social justice (Hodson, 2003). Thus, there is a need to educate students for informed action, i.e. to prepare students for action and engaging in problem solving activities. In fact, the earlier students become involved in collective action, the better prepared they are for exercising their citizenship rights in a participatory democracy. Education must be an active and critical lifelong enterprise, transcending the boundaries of classrooms and schools (Hodson, 2003).

To encourage citizens to understand science and to promote informed action, it is important to bring together public and scientists, involving the citizens in science as researchers (Kruger & Shannon 2000), i.e.,

citizen science involves citizens in academic research, bringing together non-academic community with scientists. For citizens, citizen science provides an opportunity to contribute to scientific understanding and decisions. For scientists, is an opportunity to collect information that would be impossible to gather for different reasons, such as time and resources' limitations (Tulloch et al., 2013). Educating citizens in this type of context can contribute to solve society's issues – such as poverty, injustice, terrorism, wars – as well as environmental ones – such as the ozone hole, global warming, decreasing biodiversity, among others (Bencze, 2011). This is a crucial point, given the nature of social and environmental problems currently facing society, demanding responsible and engaged citizens to actively exercise their citizenship (Bencze & Sperling, 2012). Finding an adequate solution to these issues requires thinking about sustainability education with the idea of engaging and transforming something that is ours, taking on our responsibility for the world and for others, taking into account the future of society, i.e. the coming generations (Earth Council, 2000). Thus, sustainable development presumes an improvement of the quality of life for all individuals, aiming to give each of them greater control over their destiny (UNESCO, 2005). Sustainable development can only be achieved with the strong engagement and awareness of all. This requires the development of citizen's critical awareness, allowing them to learn about and be alerted to reality, prompting them to feel engaged with it, and to assume their role as an integral part of this reality (UN, 2013).

Sustainability education is about more than developing critical awareness; it aims to create in the citizen a will to transform and to be transformed, i.e. the will to engage and act (Jurgensen, 2003). This action on social and socio-scientific issues, such as the sustainability of the Earth, requires informed, competent and empowered citizenship. The engagement in collective activism initiatives allows students to develop the skills and attitudes necessary for its liberation from the

hegemonic control of experts and businesses. Participation in activism drives students to perceive their power to intervene. Realizing that they are agents for change, they are capable of demanding and exercising participatory and informed citizenship, also demanding social and ethical justice in the interactions between science, technology, society and the environment (Reis, 2013). In order for students to be/become citizens with full rights, collective action on socio-scientific issues must be experienced in schools (Hodson, 2014; Reis, 2014).

Taking into account these issues, in this study we developed an initiative, related to a local problem (selected by the students according to what they considered more relevant), dealing with the decrease in honey production in rural areas, engaging the students in collective action. The main goal of this study is to learn about the potential of collective action, related to the reduction of bees and honey production, for students' learning and engagement. This study is part of a wider project, "We Act – Promoting Collective Activism on Socio-Scientific Issues" (Marques & Reis, 2017; Reis, 2014) aiming at the development, implementation and study of materials, methodologies and approaches that support teachers and students in carrying out informed and negotiated actions on socio-environmental and socio-scientific issues.

Method

The research design for this study is grounded in qualitative methods (Bogdan & Biklen, 1994) with an interpretative nature (Erickson, 1986). The participants were an elementary school teacher and 26 students from 3rd grade, with ages between 8 and 10. Students came from a rural setting, in inland Portugal, where agriculture is the main source of subsistence. It is a region with high honey production. Most parents have low academic qualifications, corresponding to basic education and, in most cases only elementary education. The teacher has a degree in Elementary School Teaching. She's 51 years old and has 26 years of professional experience.

During two months, students were engaged in collective action activities related to the problem "What is happening to bees?". Before starting the problem solving, the teacher asked the students to discuss what they already knew about the bees and to bring to the classroom stories related with bees (the importance of bees in their life and for their families). In a preliminary phase, this discussion was important for students' engagement in the issue.

In order for students to develop scientifically grounded actions their tasks were organized into several phases. In the first phase, the local problem was contextualized with a dialogue between two friends, Rosa and Benjamim, and their uncle Sérgio. The two friends called their uncle to inform him that they were going to be spending part of their summer holidays in his house, and to ask him to make Benjamin's favourite honey and ginger cookies. Faced with this request, the uncle answered that he could not make the cookies because in that year there hadn't been any honey production. He added that the bees were dying. From this dialogue, students identified the problem and explored it, using mainstream media as a source. After this phase, in order to better understand the issue, students participated in a role-play activity, focused on a local concern: "The president of your municipality is worried about this issue and has decided to hold a meeting with all concerned parties, to arrive at a proposal that they could send to the Ministry of Environment."

After this, students were organized into groups, and each group selected a role to play during the meeting, namely: pesticide industry representative; agricultural company representative; scientist; beekeepers' association representative; and environmental association representative. Before taking part in the discussion, students had to prepare arguments to support their role. After the discussion, they helped the President writing the letter to the Ministry of Environment with their main concerns and the final conclusions reached by all participants. They reached a consensus and wrote the letter given that they had played roles with potentially contrasting

perspectives. As a way to reach out to the local community, i.e. to develop collective action, students undertook two initiatives: (i) wrote a manifesto (figure 1) and asked the local population to subscribe it, and (ii) created slogans that would draw attention to this problem. The arguments used by students were focused in the use of pesticides. This fact is related with the information that was provided in the task (essentially directed to pesticides), conditioning their point of view.

students' classroom written records. The interview and written documents provided the data for the researchers to analyse and give meaning to the process (Bogdan & Biklen, 1994). For the analysis of data related to the potential of this particular collective action for the participants, in the teacher's perspective, we used the categories "framework for collective action" and "engaging in collective action".

Manifesto

Why are bees dying? The 3rd grade students investigated about this question and found out that the main reason for this problem is that human beings are using pesticides in agriculture. These toxic substances cause bees to become disoriented, having difficulties to find their hives. They get lost and end up dying. All people have to protect bees. Bees are very important. They pollinate, carrying pollen from one flower to another and allowing fruit production. So if we want to continue to produce and eat fruit we have to take care of the bees. Bees also produce honey that we all consume, for example, in tea or cakes. In our village a lot of honey is produced and sold to other people, being a form of subsistence. So, what can we all do? We can avoid the use of pesticides or, in the case we cannot stop using them, we can choose those who are not harmful to the bees. Let's not forget that bees are our friends!
Subscribe with us this manifest and defend the bees, saying no to the use of pesticides.

Figure 1 – Manifesto prepared by students for community action

As usual in this type of document, the manifesto constituted a declaration of principles and intentions, which sought to: a) alert to the bee's disappearance problem; b) publicly expose some of the local agricultural practices as a possible cause of the problem; and c) summon the community for a particular action – in this case, changing behaviours. The manifesto, proposed by the students and subscribed by the population, worked as a commitment to change agricultural practices, harmful to the ecosystem, and for the adoption of more environmental and sustainable methodologies. The proposals presented resulted from the students' knowledge of the agricultural practices used by their families and from the investigations they carried out, allowing them to: a) recognize the inadequacy of these practices; and b) learn about environmentally sustainable alternative practices.

Data about this process was collected through an interview with the teacher, at the end of the school year, and by the analysis of

Results

Framework for collective action

Before starting the problem solving, the students had opportunity to discuss what they already known about bees and the importance of bees for their life and their families, as well as, they had opportunity to tell stories related bee stings and honey production. This was an important moment to engage students in the project. It was a trigger for the problem solving, allowing teacher to realize what their students already known about the issue. Honey production in the region is high and it is one of the ways of the families subsist. The students have a big proximity to the bees and they help their parents to take care of the hives and on the crest of the honey, such as the teacher said: "they are used to bees, they are not afraid."

In addition, from the teacher's perspective, students efforts to answer the problem: "what is happening to the bees?", helped them to sustain their collective action, taking form in two initiatives, as mentioned in the interviews:

"it was important the initial work of identifying the problem, reading the news, realizing that they should prepare for the discussion (...) it was important because it helped them to understand that they can act if they know how, they developed new knowledge". According to her, this initial activity, before the collective action phase, is crucial to raise students' realization that each citizen should be aware and informed to make competent decisions related to their life on Earth, and to the consequences of human activities for the future of the ecosystem. In her words:

"Playing different parts allowed students to get ready, allowing people to learn, taking into account different points of view. They realize that there are different points of view, but at the same time it is necessary to intervene because it is an issue that can affect their future, how do I explain this? If it's affecting the bees, if it's an environments problem, I as a student have to do something, because if I don't, what will happen to the bees? The production of honey will reduce and so will the bees, and in the future, I might not have any more honey. On the other hand, the disappearance of bees affects the whole ecosystem because it prevents plants reproduction. Therefore, it affects the future of all living creatures. This was important for the students" (Interview).

In the teachers' words it becomes clear that students thought about the future, i.e., as citizens, if they didn't act, the problem could persist and affect the whole ecosystem and future generations. It is also visible in the interview that, from the teacher's perspective, students recognized the need to safeguard environmental, social and economic issues. As illustrated in the following example,

"I think it warned students that the use of pesticides is an environmental problem and that there is a need to intervene because it can affect beekeepers and farmers themselves by causing the bees to disappear. It was important for students to think about this before writing a manifesto for the population and slogans" (Interview).

In the previous excerpt, it is clear that the cause of death identified by the students was the use of pesticides. However, the teacher could have promoted a moment of deeper discussion. For example, teacher should have

encouraged students to discuss other causes for bees' death. In addition, the activity that students developed has focused on searching information.

Examples related to the beekeeper's profession, or the importance of producing honey for the region can be found in the students' written records:

"So, in our county bees are dying, just like in the rest of the world, and the production of honey is decreasing which affects the survival of some beekeepers" (Group 1).

"This harms bees and kills them, if we continue like this one of these days we'll no longer have honey to eat" (Group 2).

The idea presented by group 1 shows that students are aware that this problem can affect the beekeeper profession, and therefore have a local social impact.

From the teacher's perspective, this initiative facilitated the development of knowledge and skills for action. This way, students acquired scientific concepts related to the importance of bees for the pollination of flowers, and used this knowledge to support their action. In addition, it allowed them to develop other skills such as reasoning, communication and attitudes, as mentioned in the interview:

"Acquiring scientific knowledge was an important part. In order to solve the problem, it is necessary to know what bees are, what's their importance. We have to take into consideration questions related to pollination. I remember that the students asked me: Teacher, can bees really do this? They were amazed at their ability to transfer pollen from one flower to another. So, what did they learn? Scientific knowledge and other things. As they themselves say, to argue, to defend ideas, to respect their peers, to plan their communication strategy, to think, to write, to read, and also writing skills ... what have they done with all this? They used it in a very interesting way for their collective action, to reach the population" (Interview).

As we mentioned, the students were motivated to solve the problem. For this, it was important to explore the previous concepts, before the students started the task. This engagement was crucial for the project's development and for the knowledge mobilization by students as described by the teacher in the previous excerpt.

Students' written records allow us to reinforce what the teacher said during the interview. The following example points us in the same direction:

"Bees do pollination, honey and help trees produce good fruits. People need to know that bees are dying from pesticides. We have to think, investigate how to solve the problem, and argue and defend our ideas to try to change farmers' behaviours " (Group 3).

In this example, it is quite clear that students have learned scientific concepts and developed other skills that are fundamental for collective action planning.

Engaging in collective action

From the teacher's perspective, engaging in collective action allowed students to become aware that their local action is important and that as citizens they can induce change, i.e., to engage in actions leading to change in current issues:

"Preparing the initiatives and putting them into action was extremely important. By doing this they realized that they could do something, of course for this it is necessary to know what to do, to have knowledge about the subject, and to want to do it. And I heard them saying: "teacher, we did it". This is important, such as other small things, like inviting parents to come to school to see the exhibited slogans, it empowers them and is key to this feeling, i.e., I am aware of what I can do, and that someone hears me because it is important and they hadn't thought about it before" (Interview).

From the teacher's description it becomes clear that collective action was important for students, leading them to become aware that they can act as citizens. The sentence that the teacher used "teacher, we did it", supports the idea that students know that they can act as citizens, and that their initiatives are heard by the local community, i.e., students realize they can "do it themselves". Through the teacher's answer, we can notice that students' actions related to the slogans led their families to think about the socio-scientific issues being addressed.

According to the teacher, students' engagement in these two initiatives – i.e. writing the manifesto and asking the community to subscribe it; and developing the slogans raising awareness to this issue – was

very positive, and the students showed that they enjoyed it, and that it contributed to developing their critical thinking skills. Equally positive, according to the teacher, was the feedback parents and families gave about the initiatives that were carried out:

"Students were very motivated and asked "will people sign it?" and another would answer "yes, my father says he wants to read it", and another "my mother will also sign it". It really motivated students and I realized they were interested. (...) The writing of the manifesto was important because they were discussing what was really crucial to pass on to others, what was essential to say from what they had learned, and what was only accessory ... Parents came to get the kids from school and said that the children were enjoying it and that this type of task adds value to their learning" (Interview).

In the teacher's words, it is clearly visible that it was important for students that their parents signed the manifesto. The parents recognized this aspect as something that their children liked, influencing positively their learning. For the teacher, collecting signatures in the final manifesto within the community was also crucial for students and for the people who signed it. There was a responsibility for action and a realization that action is key. As mentioned,

"[families] were also asked to read the manifesto, to see if they agreed, to sign it, and see the slogans. Some of them became aware of what was happening to bees. It was important for everyone, and students saw that they can do things, small initiatives that in a small community can have real consequences (...) The manifesto was signed by families, parents, grandparents, cousins, uncles, and other people as well. In total we had 150 signatures, or close to that, it also gives us the notion that we are responsible" (Interview).

The example described in the interview shows that students were able to engage in the action several members of the local community, not only family members, but also "other people". The teacher also added that school has a fundamental role in this process, as we can see in the following excerpt:

"We are talking about a small county, with a small population. School is very important for students' lives, for their families, and for the whole population in general. There is great

recognition for school as a source of learning. Activities such as these, alerting the population and taking what the students did outside of the school are valued. This is important for students, these activities increased their motivation, leaving them wanting more, saying "teacher when do we do more?" This also came from their homes "teacher my son wakes up in the morning saying he wants to come earlier". I had comments like this! It's great because it shows that everyone's very engaged" (Interview).

This example reinforces the idea that such initiatives are fundamental to engage students in school, bringing discussion and information to local communities who recognize "school as a source of learning."

Conclusion

Engaging students in solving the problem "What is happening to bees?", relevant in their local context, was fundamental for their engagement in two collective actions. These initiatives, from the teacher's perspective, required students to mobilize scientific knowledge to support their actions and the development of several competences, such as building solid arguments to support their position, present their arguments to others and defend them, and respect for others and their ideas. Another feature highlighted by the teacher was the development of students' critical judgment, especially when they prepared the manifesto to be signed by the community, forcing them to discuss what was fundamental and what was accessory. These competences are undoubtedly essential to actively engage in society, supporting knowledge-based decision-making. Effectively, the OECD (2005) defends that, individuals need to be able to take responsibility for managing their own lives, situate their lives in the broader social context and act autonomously.

In addition, the results of this study allow us to conclude that students became aware that (1) it is important for citizens to have substantiated knowledge in order to act; (2) it is important to act because the problem may persist and impact future generations; (3) only through action can we cause change. In fact, from the teacher's interview, we can

understand that students reflected on their role as citizens and recognized that it is important to act as members of their local community. The work that preceded the implementation of the activism initiatives was important for students to feel capable of acting, i.e. it allowed students to prepare their action in a substantiated manner, to feel confident in analysing the problem and in their response to it. This is an important element when educating for sustainability, with the intention of promoting activism (Gray, Colucci-Gray & Camino, 2009; Reis, 2014). In addition, it is possible to mention that students developed the idea that human actions, in this case the use of pesticides, can have negative consequences for society, the environment and even the economy. Another aspect that stands out is the engagement of other community members. It can be noted in the teacher's descriptions that, on the one hand, students realized that they can be agents of change, and that they know how to reach others. This can be seen in the teacher's discourse when she mentions that students say "yes, my father says he wants to read it", and "my mother will also sign it", revealing that these initiatives influenced their families. On the other hand, what parents learned from their children should also be stressed. As the teacher also mentioned, they became aware of what was happening to bees. However, we recognize that the teacher's exploration of the problem could have been deeper. Pesticides are one of the probable causes of death of the bees. One of the reasons that led students to focus on the use of pesticides is related with the task. The roles played by students were directed to the use of pesticides. So, their argumentations and initiatives were related with pesticides. In order to go further, the connection with the University would be important, following citizen science approach (Kruger & Shannon 2000). This interaction could be important in order to get more support for the students claim that pesticides are the main cause of death.

According to the teacher, students' engagement in collective action related to bees was very positive, allowing them to

establish relationships between their own life, their local context and science (Lavonen et al., 2005; Trumper 2006). This study showed that, since the first years of schooling, it is possible to engage students in solving problems through collective actions about socially relevant issues. It is vital that, from an early age, every citizen realizes that engaging in action is crucial for democracy, in order to promote the necessary changes required for a fairer world, more protective of the environment, and in which everyone is an active participant. A possible development of the study could be to collect data from the local community (such as parents), allowing to know their perspectives about the collective action initiatives performed by the students.

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